Microcircuit Facility Assessment and Quality

This section describes a microcircuit facility quality areas that should be assessed and/or monitored. Use this section to establish a level of microcircuit quality and to support an assessment of a facility when required.

Although the DOD does not require the use of ISO 9000, the military uses it as its quality standard. ISO 9000 is an international quality standard used by the majority of microcircuit manufacturers and system builders. ISO 9000 should be used in conjunction with the microcircuit performance specification, MIL-PRF-38535, in developing and administering a microcircuit quality system. The automotive industry uses QS 9000, which is tailored to the automotive industry and is an acceptable alternative. Non-military microcircuit facilities should have, as a minimum, an ISO 9000 quality system.

MIL-PRF-38535

The military uses “Microcircuit Manufacturing Performance Specification” (MIL-PRF-38535) as the standard for performance, quality and reliability assurance for microcircuits. Therefore, when assessing a microcircuit facility, MIL-PRF-38535 should be used. This specification will assist in tailoring for critical and complex performance concerns related specifically to the microcircuit arena. MIL-PRF-38535 has four quality and reliability classes:

a. Class M microcircuits have been subjected to and passed all applicable requirements of Appendix A of MIL-PRF-38535 and are documented on an SMD (Standard Military Drawing).

b. Class N have been subjected to and passed all applicable requirements of MIL-PRF-38535 including qualification testing, screening testing, and TCI/QCI inspections, and are encapsulated in plastic.

c. Class Q have been subjected to and passed all applicable requirements of MIL-PRF-38535 including qualification testing, screening testing, and TCI/QCI inspections.

d. Class V have meet all the Class Q requirements and have been subjected to and passed all applicable requirements of Appendix B of MIL-PRF-38535. This Class is for Space level products.

Qualified MIL-PRF-38535 microcircuits and manufacturers are listed in the QML-38535 (Qualified Manufacturer List).

Facility Assessment

A recommended facility assessment checklist for microcircuits is described below. Use this in conjunction with ISO 9000. The manufacturer should have the following process baseline:
Design - Circuit design and performance characteristics:

a. Model verification. Provide evidence that all models used in the design process are functional, predictable and accurate over the worst case temperature and electrical extremes. Examples are transistor behavioral, logic, fault, timing, simulation, fabrication, assembly and package models.

b. Layout verification. Demonstrate the capability of the automated or manual procedures routinely used for design, electrical and reliability rule checking to catch all known errors singly and combinations. These rules cover, as a minimum:

1. Design Rules Check (DRC): Geometric and physical.

2. Electrical Rules Check (ERC): Shorts and open, connectivity.

3. Reliability rules: Electromigration and current density, IR drops, latch-up, Single Event Upset (SEU), hot electrons, ESD, burnout backgating.

c. Performance verification. The manufacturer should design and construct a chip or set of chips to assess the process capability to perform routing and to accurately predict post-routing performance. The manufacturer should demonstrate that the actual measured performance for each function over temperature and voltage falls between the two worst-case simulated performance limits. All critical minimum geometric and electrical design rules should be stressed via a test vehicle. The electrical stress requirements for the transistors and interconnects on these structures should be worst case conditions. Failure analysis should be conducted to identify all failure mechanisms, and actions should be taken to correct any problems found.

d. Testability and fault coverage verification - The manufacturer should demonstrate a design style and a Design-For-Test (DFT) methodology that, in conjunction with demonstrated CAD for test tools, can provide 99 percent or greater fault coverage on a design of reasonable complexity. The manufacturer should demonstrate

the fault coverage measurement (fault simulation, test algorithm analysis, etc.) capability which is used to provide fault coverage statistics of the design that uses the demonstrated design style, DFT method and CAD for test tools. For non-digital microcircuits, the fault coverage requirement may not be applicable, but should be supplemented as measures of analog fault coverage become better defined. For microcircuits with both analog and digital functions, this requirement fully applies to the digital portions of the microcircuits.

Package. The thermal resistance should be determined for all packages used. The following electrical characterization parameters should be addressed:

a. Ground and power supply impedance. Packages used should be minimal contributors to ground and power supply noises. This requirement can be met either by documented package design rules or through testing of the packages.

b. Cross coupling effects. Cross coupling of wideband, digital signals and noise between pins in packages used for digital microcircuits should be minimized. This requirement can be met either by documented package design rules or through testing the packages.

c. High voltage effects. The voltage applied to a package should not produce a surface or bulk leakage between adjacent package conductors (including leads or terminals). This requirement can be met either with documented high-voltage package design rules aimed at minimizing bulk or surface leakage, or through testing of the high voltage packages.